The Co-Movement between Exchange Rates and Stock Prices in an Emerging Market

(Pergerakan Bersama antara Kadar Pertukaran dan Harga Saham di Pasaran Baru Muncul)

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ABSTRACT

The aim of this paper is to examine the co-movement between exchange rates and stock prices of both the market and industries (industrial products and consumer products) in Malaysia from March 1994 to December 2013. Motivated by inconclusive evidences of previous studies to support the flow oriented and stock oriented hypothesis, the study applied error correction model including the Long Run Structural Model (LRSM) and variance decompositions to examine the relationship between exchange rates and stock prices. The findings suggest that the direction of causality runs from exchange rates to stock prices which are consistent with flow oriented theory. The influence of exchange rate, however, varies across industries with importing firms appearing as the most affected; indicating that Malaysian market is not homogenous. The major policy implication that can be deduced from the study is that active policy on currency management through monetary instrument (i.e. interest rates) will be helpful to stimulate the development of stock market in emerging countries like Malaysia.

Keywords: Exchange rates; stock prices; LRSM; variance decomposition; error correction model

ABSTRAK

Kajian ini bertujuan untuk mengkaji pergerakan bersama antara kadar pertukaran dan harga saham kedua-dua pasaran dan industri (produk industri dan produk pengguna) di Malaysia dari Mac 1994 hingga Disember 2013. Didorong oleh bukti-bukti yang tidak meyakinkan daripada kajian lepas untuk menyokong hipotesis orientasi aliran (flow oriented) dan orientasi saham (stock oriented), kajian ini dilaksanakan untuk meneliti hubungan antara kadar pertukaran dan harga saham dengan menggunakan model pembetulan ralat (error correction model) termasuklah Model Struktur Jangka Panjang (Long Run Structural Model [LRSM]) dan penghuraian varians (variance decomposition). Hasil kajian menunjukkan bahawa arah penyebab berlaku dari kadar pertukaran kepada harga saham yang konsisten dengan teori orientasi aliran. Pengaruh kadar pertukaran, bagaimanapun, berbeza-beza di antara industri dan didapati bahawa syarikat pengimport adalah yang paling terjejas, yang menunjukkan pasaran Malaysia tidak seragam. Implikasi dasar utama yang boleh disimpulkan dari kajian ini adalah bahawa dasar aktif dalam pengurusan mata wang melalui instrumen kewangan (iaitu kadar faedah) akan membantu merangsang pembangunan pasaran saham di negara-negara membangun seperti Malaysia.

Kata kunci: Kadar pertukaran; harga saham; LRSM; penguraian varians; model pembetulan ralat

INTRODUCTION

Recently, history repeats itself when the roots to global crisis have been linked to the quantitative liberalization policy adopted by many giant economies such as the United States, the United Kingdom and the Eurozone that has led to substantial capital inflows across continents which then has undergone currency shocks with consequent overwhelmingly negative pressure on the stock markets and the economies. Given that the key feature of the occurrence of crisis was the simultaneous fall in currency and stock prices, the issue on the linkage between the two has caught a considerable amount of attention from: economists, investors and policy makers. Theoretically, the direction of causality between exchange rates and stock prices can be viewed from two different angles.

On one hand, the 'flow oriented' model (Dornbusch & Fischer 1980) states that exchange rate fluctuations affect international competitiveness and then the less favourable terms of trade may affect real income and thus stock prices. Furthermore, because the value of a stock equals the discounted sum of its expected future cash flows, they react to macroeconomic events including exchange rate changes. On the other hand, the 'stock-oriented' model (Branson 1983; Frankel 1983) posits that innovations in stock market determine the wealth of investors in demanding for money. For instance rising stock price encourages capital inflows and thereby increases the demand for and thus appreciation of local currency.

On the empirical front, a number of academic researches have been conducted to verify the interaction between exchange rates and stock prices by using

different samples and methodologies; yet the findings have been mixed. Some studies found limited evidence of relationship between exchange rates and stock prices (for instance Rahman 2009; and Zhao 2010), while others (Pan, Fok & Liu 2007; Jayasinghe & Tsui 2008; and Yau & Nieh 2009) found that significant relationship and the causal direction run from exchange rate to stock price. Interestingly, Lin (2012) found that during crisis, the channel of spill-overs runs from stock prices to exchange rates. Such inconclusive evidence suggests that further analysis is needed to shed light on the issue.

The aim of this study is to examine the co-movement between exchange rates and stock prices particularly in Malaysia. We concentrate on Malaysia since this country uses a trade-led approach to stimulate its economic growth, in which the percentage contribution of trade to their GDP is high - relative to other sectors. This is in support to the goods market approach which emphasizes on the significance of the size of trade. Moreover, Malaysia is undertaking 'manage-float' exchange rate regimes; with the financial authority intervenes in the foreign exchange market through monetary instruments in order to manage exchange rate fluctuations. Motivated by this, we include interest rate as an additional variable so as to fully capture the relationship between exchange rates and stock prices. Besides examining the relationship between exchange rates and stock prices of the market in general, we also include two other main export and import based industries (industrial products and consumer products) in the study so as to examine how the exchange rates influence the stock prices at a disaggregated sector level. Based on the argument provided by Narayan and Sharma (2011) that different sectors have different market structures and thus are heterogeneous, it is contended that exchange rates are likely to affect stock prices differently in different sectors. In addition, studying the effects of exchange rate fluctuations from the sector analysis is important since any market-wide consequences may mask the performance, not necessarily uniform, of any one sector.

Basically, the questions raised from the above issues are:

1. Are exchange rates and stock prices related? If so, in which causal direction are they integrated?
2. Does co-movement between exchange rates and stock prices differ across industries, thus indicating the importance of industrial factor in the interactions between asset markets?
3. Which variable is the most influential in affecting the relationship and how policy intervention can stimulate the interaction of the asset prices?

The results of this study will provide several implications especially for investors, risk managers, portfolio managers and policymakers. Besides being able to formulate investment decisions, knowing the relationship between the two variables is relevant in understanding the flow of information between stock and foreign exchange markets which may also be useful for assessing informational efficiency of emerging stock markets. From the perspective of portfolio management, identifying the heterogeneity of sector sensitivities to exchange rate fluctuations provides information on which sectors can provide a means of diversification during ups and downs of exchange rates. In addition, in the area of risk management- specifically for risk managers or portfolio hedgers - it is crucial to spell out how markets are linked over time in order to develop an effective hedging strategy. For the authorities, the implication could be in the form of developing financial planning of the country through monetary and exchange rate stabilization policies to boost the local stock market.

This study differs from previous studies that examined Malaysian data such as Pan et al. (2007) in several ways. First, they have studied the relationship between exchange rates and the aggregate market index by assuming that sectors making up the market are homogenous. Secondly, while their study examined the relationship using data before the 1997 Asian financial crisis i.e. for the period from January 1988 to October 1998, this study uses the most recent data from March 1994 to December 2013. More importantly, we applied a multivariate time series technique in a single country; in particular, co-integration, error correction modelling (including LRSM) and variance decompositions in which according to some studies, the results of the study in this area are sensitive to the methodology employed.

The rest of the paper is structured as follows. Section 2 discusses the theoretical foundations and provides a brief review of literatures related to the relationship between exchange rates and prices. Section 3 presents the data and methodology while Section 4 reports and discusses the empirical results. Finally, section 5 summarizes the study and section 6 provides the limitations of the study and suggests improvements for future researches.

LITERATURE REVIEW

Theoretically, the relationship between exchange rates and stock prices can be explained by several approaches. The goods market hypothesis (also known as traditional approach) by Dornbusch and Fischer (1980) presents the flow-oriented model which suggests that changes in exchange rates affect the competitiveness of multinational firms and hence their earnings and stock prices. For the exporting firms, a depreciation of the local currency makes exporting goods cheaper and may lead to an increase in foreign demands and sales; while on the other hand, an appreciation of the local currency makes the firm's profit decline and so does its stock price because of the decrease in foreign demand of an exporting firm's products. In contrast to the exporting firms, for the importing firms, they would be at a disadvantage position when there is depreciation of local currency. Thus, the value sensitivity of importing firms to exchange rate changes is just the opposite; hence an appreciation (depreciation) of the

local currency leads to an increase (decrease) in the firm value. Moreover, according to Gordon's valuation model, since the values of financial assets are determined by the present values of their future cash flows, expectations of relative currency values play a considerable role in their price movement, therefore, stock price innovations may be affected by exchange rate dynamics. Additionally, Branson (1983) and Frankel (1983) present the stock-oriented model (also known as portfolio balanced theory) which views the causality runs from the stock market to the exchange rates. They argue that innovations in stock market determine the wealth of investors for the supply of and demand for money. Therefore, rising share market would attract capital inflows that leads to increases in the demand for and thereby appreciation of local currency. In contrast, decreases in stock price reduce the liquidity in the market which in turn reduces the demand for money with ensuing lower interest rates. Subsequently at lower interest rates, it discourages capital inflows, ceteris paribus and causes depreciation of the local currency.

On the empirical front, a number of studies have examined the relationship between exchange rates and stock prices with limited evidences on the significant of exchange rate exposure. For instance, a study by Rahman (2009) shows no causal relationship between stock prices and exchange rates in Bangladesh, India and Pakistan. In the case of China, a study by Zhao (2010) also supports previous studies that find limited evidence on the relationship between the two variables. Particularly, it analyses the dynamic relationship between Renminbi (RMB) real effective exchange and stock price in China using VAR and multivariate GARCH models from January 1991 to June 2009 and found that there is no stable long-term equilibrium relationship between RMB real effective exchange rates and stock prices. Other studies however, found significant relationship and the causal direction run from exchange rates to stock prices. For instance Yau and Nieh (2009) investigated the causality between the New Taiwan dollar against the Japanese Yen (NTD/JPY) and stock prices in Japan and Taiwan from January 1991 to July 2005 and found long-term equilibrium and asymmetric causal relationships. Similarly, Pan et al. (2007) examined dynamic linkages between exchange rates and stock prices for seven East Asian countries, including Malaysia for the period of January 1988 to October 1998 using Granger causality tests, variance decomposition analysis and impulse response analysis. Interestingly, whilst there is no evidence of showing any countries' stock market affect exchange rate during Asian crisis, a causal relation from exchange rates to stock prices has been found for all countries except Malaysia. In a later study, Zakaria and Shamsudin (2012) examines the relationship between stock market returns volatility in Malaysia with five selected macroeconomic volatilities; GDP, inflation, exchange rate, interest rates and money supply based on monthly data from January 2000 to June 2012. Their study found little support on the existence of the relationship between stock market volatility and macroeconomic volatilities including exchange rates. They explained that the weak relationship between stock market volatility and macroeconomic volatilities is due to lack of institutional investors in the market, and may also indicate the existence of information asymmetry problem among investors. On the other hand, in the case of Vietnam, Huy (2016) found causal relationship from stock prices to exchange rates. Based on several procedures: Johansen and Juselius (1990) co-integration test; Toda and Yamamoto (1995) short-run dynamic causal relationship; and variance decompositions analysis on daily data from 2005 to 2015, the findings show in consonance of stock oriented theory. For China, Cuestas and Tang (2015) also provided consistent evidence showing unidirectional causality from stock market to foreign exchange market. In addition, using MS-SVAR approach, the study indicates that the spill-over effects during financial crises have longer durations. Similarly, the stock oriented theory also exists in Nigeria (Effiong 2016), in which the dependence becomes strengthened during the period of market bubbles.

All of the above studies have examined the relationship between exchange rates and stock prices using aggregate market index. Narayan and Sharma (2011) claimed that such a study has the limitation, in that, they assumed that firms and indeed sectors making up the market are homogenous. They further argued that different sectors have different market structures and are thus heterogeneous. In line with this argument, Jayasinghe and Tsui (2008) examined exchange rate exposure on Japanese industries. Based on a sample data of fourteen sectors, they found significant evidence of exposed returns but the effect varied, in that, some industries were positively affected while others were not. Lin (2012) complemented the earlier studies by using ARDL method in examining the impact of both Asian and global crises on the relationship between exchange rates and industries' stock prices in India, Indonesia, Korea, Philippines, Thailand and Taiwan. She concluded that the co-movement between variables gets stronger during crisis periods as compared to normal period, and the channel of spill-overs run from stock prices to exchange rates. She argued that however, the co-movement is not stronger for export based industries for all periods thus concluded that the capital account balance (rather than trade) is an important factor in affecting the relationship. Recently, Mouna and Anis (2016) examined the causality links between the market, exchange rates, the interest rates, and the stock returns of three financial sectors (financial services, banking and insurance) from US and European countries over the period of 2006-2009, found mixed evidence (significant positive and negative effects). However, Safitri and Kumar (2015) found that exchange rate and other macroeconomic factors (i.e. interest rates and inflation) have no significant influence in explaining Indonesia Plantation sector's stock price during 2008-2012. In sum, the above studies show that there is no consensus among researchers on the exchange rate-stock price relationship, suggesting further studies are warranted to revisit the issue.

METHODOLOGY

The data used are monthly stock price indexes for KLCI, Consumer Products, Industrial Products, exchange rates (expressed in NEER), 1-month KLIBOR for the period from March 1994 to December 2013 in Malaysia. All data were obtained from the Datastream database. This study uses multivariate time series approach, in examining the lead-lag relationship between exchange rates, interest rates, market index, main export-based industry index (industrial products) and main import-based industry (consumer products) index in Malaysia[1]. Based on CUSUM Square test, we also included dummy for Asian crisis and global crisis into the model to account for the systematic changes or structural breaks during the periods.

The straight lines represent critical bounds at 5% significance level
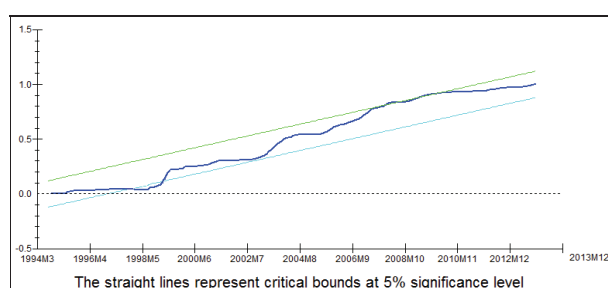
FIGURE 1. Cumulative sum of squares of recursive residuals

     Since the exchange rate index is measured in Malaysian NEER (MYR per pool of major currencies being traded with), therefore an increase value for this index indicates a depreciation of Ringgit Malaysia against the traded currencies. According to theory of flow oriented (Dornbusch & Fischer 1980), depreciation is expected to increase the exporting firms' value while appreciation is expected to increase the value of import based industry. Therefore, it is predicted that there is a positive relationship between the NEER and export based industry and negative relationship between the NEER and importing industry. For market return, it could be explained with the focus put on capital account where favourable foreign exchange rate will encourage capital inflows in equity investment. Therefore, the relationship is expected to be positive. While based on the Gordon's value model, it is expected that the increase in interest rates represent the increase in cost of capital that will lead to decrease in the firm's value and thus the relationship is expected to be negative.

     To achieve our objectives, there are a number of procedures that we used in the study following Masih and Masih (2001). In order to proceed with the co-integration test, we have conducted both unit root test (i.e. to ensure stationary at I(1)) and the order of VAR. We employed both Engle Granger test and Johansen test to find co-integration between the variables. We further used the long run structural model (LRSM) to test the co-integrating vectors against the theoretical expectation values that

subject to exact identification and over identification. We have analysed thus far, the theoretical part whether or not the variables are moving together in the long run to rule out spurious relationship between the variables. However, the co-integration test was not able to tell the direction of causality between the variables i.e. which variable is exogenous and which is endogenous. To capture the causality relationship, we used the vector error correction model (VECM) which can also indicate the Granger causality in the short run and long run. However, VECM has its limitation, in that, it only tells the absolute causality but not the relative causality i.e. which variable is the strongest leader and which is the weakest follower. That was done by the test of variance decomposition by decomposing the variance of the forecast error of a variable into proportions attributable to shocks from its own past and from each variable in the system. A variable that can mostly be explained by its own shocks is the strongest leader among the variables under study. Then we applied the impulse response functions (IRFs) to map out the dynamic response path of all variables when a one-period SD of specific variable is shocked. Finally, we tested for system-wide shock by using persistence profile test or in particular, to estimate the speed with which all the variables get back to equilibrium if the entire co-integrating equation is shocked.

RESULTS

Figure 1 shows the trend of index series for all variables under study. The first point to notice is that there is a huge slump in all series during 1998 Asian financial crisis. Both sectors including the market seem to have been impacted as indicated by their significant drop in the stock prices. As expected, the value of NEER also decreased along with the increasing KLIBOR. During the later important event i.e. global crisis in 2007/2008, the impact appears moderate since the market participants have learned from the previous crisis. In general, after the 1998 Asian financial crisis, all indexes have gone through an upward trend except for the NEER and the KLIBOR which have adjusted within some waves and ripple cycles following the regulatory policy.

     Table 1 reports the descriptive statistics of monthly (log of) KLCI, two main industries stock prices, NEER and KLIBOR. It appears that among other variables, LNER has the smallest standard deviation while KLB has the largest variance from its mean value. The results show that during the study period, the two industries (LCSM and LINP) offer lower price than the market and the market provides the highest price among all series. For investment-wise, the resulting coefficient of variation (CV=σ/k) suggests that as expected, the market provides the safest risk-return profile with the lowest risk per unit of price (CV = 0.05) compared to LCSM (0.08) and LINP (0.07).

     Ideally, co-integration test requires all variables to be I(1), in that, they should be non-stationary at the original
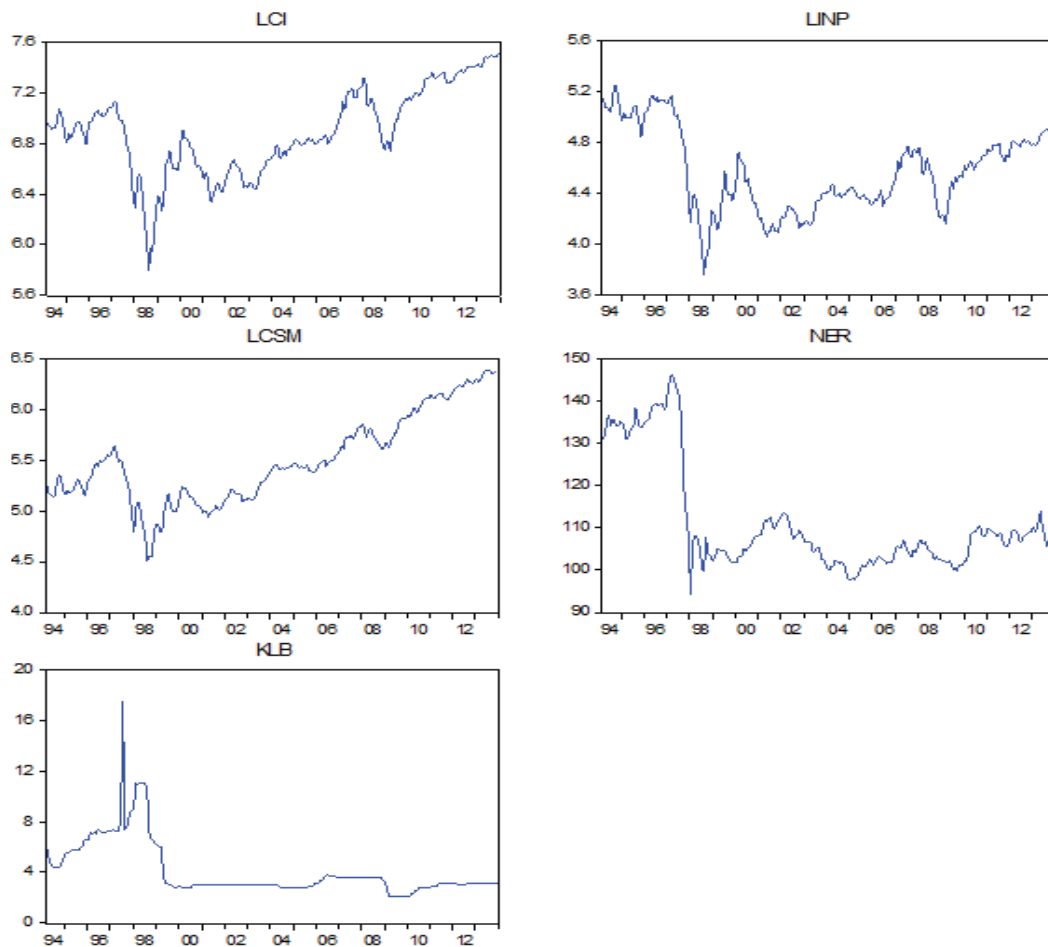
FIGURE 2. Patterns of Index Series for (log of) KLCI, (log of) Two Main Sectors (Consumer Products and Industrial Products) and (log of) NEER, KLIBOR

TABLE 1. Descriptive Statistics

	LCI	LCSM	LINP	LNER	KLB
Mean	6.8891	5.4973	4.5686	4.709	4.0985
Median	6.8717	5.4332	4.5377	4.670	3.1000
Maximum	7.5177	6.3928	5.2526	4.985	17.5000
Minimum	5.7930	4.5087	3.7612	4.544	2.0900
Std. Dev.	0.3394	0.4385	0.3216	0.110	2.1590

Note: L (log) CI = KLCI; CSM = Consumer Products; INP = Industrial Products; NER = NEER; and KLB = KLIBOR

level and stationary at first-differenced level. This is to ensure that all variables contain the trend (i.e. long term information) for the purpose of testing the theoretical relationship among the variables in the long run. To test for unit root, we conducted both the Augmented Dickey-Fuller (ADF) test and Phillip Perron (PP) Test. The ADF test results in Table 1 suggest that based on AIC and SBC criteria, all variables are not stationary at the level form, for their t-Statistic values are lower than the critical value. Therefore, we failed to reject the null hypothesis that the variables are non-stationary. This inference can be supported by looking at the trend embodied in each variable as presented in Figure 1. This trend element

depicted the changing mean of the variable throughout the study period. However at the first difference, all variables are stationary at I(1), and the null hypothesis of non-stationary is rejected. This can be evidenced in Figure 3 showing all variables following constant means, variances and covariances.

In Table 3, the PP Test at the log form, on the other hand, shows all variables are non stationary (i.e. the t-statistic values are lower than the critical values) except KLIBOR. The null hypothesis of non-stationary is not
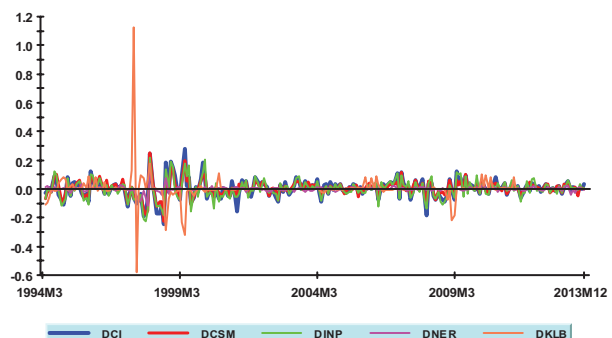

FIGURE 3. Patterns of variables in differenced form

TABLE 2. ADF test

Variables	ADF	Values	T-Stat.	C.V.	Results
Level form					
LCI	ADF(1)	305.1522	-0.223	-3.430	Non-Stationary
		312.0457	-0.158	-3.430	Non-Stationary
LCSM	ADF(1)	354.9980	-2.332	-3.430	Non-Stationary
		361.8915	-2.332	-3.430	Non-Stationary
LINP	ADF(1)	299.4618	-2.314	-3.430	Non-Stationary
		306.3553	-2.314	-3.430	Non-Stationary
LNER	ADF(3) = SBC	587.9482	-2.057	-3.430	Non-Stationary
	ADF(1) = AIC	595.5349	-2.292	-3.430	Non-Stationary
KLB	ADF(5) = SBC	-311.1342	-2.208	-3.430	Non-Stationary
	ADF(1) = AIC	-299.3734	-3.033	-3.430	Non-Stationary
First-difference form					
DCI	ADF(1)	302.0766	-9.595	-2.874	Stationary
		307.2403	-9.595	-2.874	Stationary
DCSM	ADF(1)	354.2864	-10.065	-2.874	Stationary
		359.4500	-10.065	-2.874	Stationary
DINP	ADF(1)	297.2615	-9.540	-2.874	Stationary
		302.4251	-9.540	-2.874	Stationary
DNER	ADF(1) = SBC	585.101	-10.181	-2.874	Stationary
	ADF(2) = AIC	591.4675	-7.336	-2.874	Stationary
DKLB	ADF(1)	208.3718	-11.835	-2.874	Stationary
		213.5354	-11.835	-2.874	Stationary

rejected for all variables but not for KLIBOR which the null is rejected. At the first-differenced form, the study rejects the null hypothesis that all variables are stationary. In comparison, PP test has the advantage of correcting both the autocorrelation and heteroscedasticity problems by using the Newey-West adjusted-variance method while ADF test only corrects the autocorrelation problem. However, for the purpose of this study, our position is to rely on ADF test since it is the convention test for unit root.

TABLE 3. Phillips Perron test

Variables	T-Stat	C.V	Results
Level form			
LCI	-1.8043	-3.43	Non-Stationary
LCSM	-1.6963	-3.43	Non-Stationary
LINP	-1.5503	-3.43	Non-Stationary
LNER	-1.8293	-3.43	Non-Stationary
KLB	-5.218	-3.43	Stationary
First-differenced form			
LCI	-11.5255	-2.874	Stationary
LCSM	-11.137	-2.874	Stationary
LINP	-11.7294	-2.874	Stationary
LNER	-13.2999	-2.874	Stationary
KLB	-17.4841	-2.874	Stationary
LCI	-11.5255	-2.874	Stationary

The order of the vector auto regression (VAR) is conducted to determine the number of lags to be used in testing the co-integration. The following table shows the suggested lags based on the AIC and the SBC criteria.

TABLE 4. Lag order identification

Optimal Order	AIC	SBC	p-Value	C.V.
2	1699.4	1618.7	[.000]	10%

Choosing the right length is vital to validate the subsequent tests. Since this study uses high frequency of monthly data which is subject to lag effect, we ignored the highest value suggested by AIC and SBC, if there is, in the first 0 and 1 lag. It appears that the choice of lag length is 2, given that both highest AIC and SBC give similar results. For the purpose of testing co-movement among variables in the long term, we employed both Engle Granger and Johansen tests. The former test uses residual based approach while the latter test uses maximum likelihood. However Engle Granger test can only identify whether or not there is presence or absence of co-integration in the long run, whereas Johansen test allows us to identify the possibility of having more than one co-integrating vector being present.

Table 5 shows the result of residual approach of Engle Granger. It indicates that based on the AIC and SBC

TABLE 5. ADF tests for variable residual

ADF	Values	T-Stat.	C.V.
ADF(1) = SBC	491.5719	- 4.336	- 3.430
ADF(1) = AIC	498.4654	- 4.336	- 3.430

TABLE 6. Johansen result

H_0	H_1	Statistic	95% Critical Values	90% Critical Values
Maximal Eigenvalue statistics				
r = 0	r = 1	37.86	37.29	35.04
r<= 1	r = 2	25.95	31.79	29.13
Trace statistic				
r = 0	r>= 1	105.34	87.17	82.88
r<= 1	r>= 2	68.05	63	59.16
r<= 2	r>= 3	42.09	42.34	39.34

criteria, the null of non-stationary in error term is rejected; given the t-statistic value is higher than the critical value. Stationary of error term implies that the difference between variables narrows, that is, they move together in the long term (i.e. theoretically related).

Based on Johansen Test of Maximal Eigenvalue, we found that there is only one co-integrating vector among the variables; given the t-statistic value is more that 95% critical value. Therefore, the null hypothesis of having no co-integration is rejected. Whereas, in Trace test, we found that there are 2 co-integrating vectors among the variables. However, in support of Johansen and Julius (1990) who reported that Maximal Eigan value as more reliable than the Trace Test in identifying the number of co-integrated variables; we assumed that there is only one co-integration

among the variables. The co-integration implies that the linear combinations between these variables are stationary in the long run. It shows that the relationship between the variables is not spurious, in that, there is a long term equilibrium relationship among the variables. In other words, it also implies that each variable contains information for the prediction of other variables.

Previously, we established a theory of co-integration among the variables under studies. However in order to test whether the coefficients of the co-integrating vector are consistent with the theoretically expected values and whether the variables are statistically significant in affecting the relationship in the long run; we applied the LRSM. Since our main focus was to identify the direction of causality between the stock price (LCI) and exchange rate (LNER), we first did normalization restriction by making LCI as equal to 1 at the exact identification stage (Panel A). Secondly, in order to recheck whether the insignificant variables found at the first stage are in fact insignificant, we employed further restrictions at the over identification stage (Panel B to E).

The result from exact identification shows that only LINP is significant in affecting the relationship. However in over identification, all variables were found significant (i.e. given their p-value of chi-square are significant at 10%) except KLIBOR (Panel E). We failed to reject that the restriction of coefficient vector of KLB as equal to zero and thus the null stands. However, we chose to retain the KLIBOR in the relationship since in Malaysian case, classified as "managed float" exchange rate regime country, the central bank might intervene in the foreign exchange market to influence the currency in favourable direction. For instance, when there is a sharp depreciation due to speculative attacks on the currency market, the local monetary authority may raise interest rates to reduce capital outflows. At a higher interest rate however, it may exert negative shock on stock prices. Yet, since Malaysia

TABLE 7. Exact and over identifying restrictions on the co-integrating vector

Variables	Panel A	Panel B	Panel C	Panel D	Panel E
LCI	1.0000	1.000	1.000	1.000	1.000
	(*NONE*)	(*NONE*)	(*NONE*)	(*NONE*)	(*NONE*)
LCSM	.96623	0.00	-.50057	.47826	1.4645
	(.63413)	(*NONE*)	(1.5980)	(.42873)	(.80021)
LINP	-1.3647	-.77900	0.00	-1.1870	-1.6684
	(.37527)	(.088123)	(*NONE*)	(.29850)	(.45842)
LNER	-1.0599	-.53683	-6.4439	0.00	-1.1547
	(.70807)	(.49617)	(11.7291)	(*NONE*)	(.90231)
KLB	.020549	.036416	.35540	.010940	0.00
	(.016831)	(.015879)	(.51295)	(.015488	(*NONE*)
Trend	-.0093995	-.0033997	-.0026292	-.0058131	-.012472
	(.0040539)	(.3962E-3)	(.014380)	(.0024988)	(.0051704)
CHSQ(1)	NONE	4.2233[.040]	3.5866(.058)	4.2679(.039)	1.2333(.267)

uses a trade-led approach to boost exports, the country has controlled the exchange rate through its monetary policy at a desired level. Therefore, we assumed interest rate as relevant in affecting the co-integrating relationship in the long run.

From the above analysis, we arrive at the following co-integrating equation (standard deviation is given in parentheses)[2]:

$$LCI + 1.46\ LCSM - 1.67\ LINP - 1.15\ LNER \rightarrow I(0)$$
$$(0.63) \qquad (0.38) \qquad (0.71)$$

In VECM, the test enables us to identify which variable is exogenous and endogenous by looking at the significance of the error correction coefficient, e_{t-1}, that originates from the error term found in the LRSM equation. If the error term shows significant, then that particular variable is endogenous or if otherwise, it is exogenous. Other than that, error correction model also breakdowns changes in variables into short term and long term components. While the error correction term stands for the long term relations among the variables, the impact of each variable in the short term is given by the F-test of the joint significance or insignificance of the lags of each of the 'differenced' variable. In addition, the coefficient of e_{t-1} also produces an idea of how long it will take to get back to long term equilibrium if that particular variable is shocked. The result from Table 8 shows that all stock prices index are endogenous, given the significance in their error correction term, while the LNER and KLB are

exogenous. The significance of the error correction term in stock markets implies that the deviation of the variables (represented by the error term) has a significant feedback effect on the stock prices that bear the brunt of short-run adjustment to bring about the long term equilibrium. While for exchange rate and interest rate, being the exogenous variables, they would transmit the effect on economic shocks to the stock markets. In other words, it indicates that stock price of the market and the industries depends on exchange rate and interest rate. This finding shows support to flow oriented theory (Dornbusch & Fischer 1980), in that, in the case of Malaysia, the direction of causality flows from exchange rate to stock price. Based on this result alone, it provides a general idea on the importance of exchange rate stability and monetary element i.e., interest rate in nourishing the stock markets in Malaysia. For equity investors, monitoring the movement in exchange rate on account of news in monetary policy and other important developments and events would be of interest since they would affect their returns in a significant way. Additionally, they may also have interest on the value of coefficient of e_{t-1} of exchange rate (0.139) and interest rate (0.666). For instance, if there is a shock applied on the exchange rate, it will take about 1.4 months for the exchange rate to get corrected to equilibrium together with the other variables in the model. Nonetheless, for better indicator of which variable is the most influential, variance decompositions will provide the result.

TABLE 8. ECM (-1) results

ECM1(-1)	Coefficient	Standard Errors	T-Ratio [Prob.]	C.V.	Results
dLCI	-.17323	.047189	-3.6710[.000]	10%	Endogenous
dLCSM	-.12942	.037542	-3.4473[.001]	10%	Endogenous
dLINP	-.095175	.048232	-1.7059[.050]	10%	Endogenous
dLNER	.017954	.013925	1.2893[.199]	10%	Exogenous
dKLB	1.0976	.66623	1.6475[.101]	10%	Exogenous

The diagnostic test as presented in Table 9 indicates that model 5 (dKLB) is clearly not well specified and all models are subject to the problem of non-normality and heteroscedasticity[3]. With regard to functional form and autocorrelation problem, all equations of ECM are free from the linear violations except equation of ECM on dLNER for

the former and dLCSM for the later. For structural stability, we have corrected the problem by incorporating dummies in the relationship (see previously Figure 2). Yet, for this study, we decided to relax on these linearity assumptions and proceed with our model.

TABLE 9. Diagnostic test of the equations of ECM

	dLCI		dLCSM		dLINP		dLNER		dKLB	
CHSQ SC	16.58	[0.17]	21.38	[0.05]	18.49	[0.10]	18.03	[0.12]	39.66	[0.00]
CHSQ FF	1.23	[0.27]	0.05	[0.83]	1.16	[0.28]	5.08	[0.02]	74.00	[0.00]
CHSQ N	131.04	[0.00]	244.71	[0.00]	38.53	[0.00]	4210	[0.00]	67983	[0.00]
CHSQ Het	6.86	[0.01]	4.36	[0.04]	20.89	[0.00]	21.08	[0.00]	31.73	[0.00]

The VDCs test is complement to the earlier test in proving the relative or the order of exogeneity by ranking the strongest leader and the weakest follower. The VDCs decomposes the variance of forecast error of each variable into proportions attributable to shocks from each variable in the system, including its own. The variable that is explained mostly by its own past variations and relatively less from other variables is the leading variable. There are two ways of identifying the relative exogeneity: generalized and orthogonalised approach. However, the generalised approach is preferred because orthogonalised is sensitive to the ordering of the variable in the VAR. It assumes that when a particular variable is shocked, all other variables are switched off while for generalised approach, it is invariant to the ordering of the variable in the VAR and produces one unique result (i.e. it allows all variables to adjust when a shock is applied on a particular variable).

TABLE 10. Percentage of forecast variance explained by innovations in generalised approach and orthogonalised approach

	Generalised Approach						Orthogonalised Approach				
Years	LCI	LCSM	LINP	LNER	KLB	Years	LCI	LCSM	LINP	LNER	KLB
Relative variance in LCI						Relative variance in LCI					
0.5	35%	25%	32%	6%	0%	0.5	89%	1%	8%	1%	0%
1	34%	23%	35%	8%	0%	1	76%	2%	17%	4%	0%
2	32%	21%	36%	10%	0%	2	68%	3%	24%	5%	0%
3	32%	20%	37%	10%	0%	3	64%	3%	26%	6%	0%
Relative variance in LCSM						Relative variance in LCSM					
0.5	28%	32%	32%	8%	0%	0.5	80%	11%	7%	1%	0%
1	26%	29%	34%	10%	0%	1	70%	9%	17%	3%	0%
2	25%	28%	36%	12%	0%	2	62%	8%	24%	5%	0%
3	24%	27%	36%	12%	0%	3	60%	8%	27%	6%	0%
Relative variance in LINP						Relative variance in LINP					
0.5	30%	26%	38%	6%	1%	0.5	76%	1%	22%	0%	0%
1	29%	25%	39%	7%	1%	1	67%	1%	31%	1%	0%
2	28%	23%	41%	7%	1%	2	60%	0%	37%	2%	0%
3	28%	23%	41%	8%	1%	3	58%	0%	39%	2%	0%
Relative variance in LNER						Relative variance in LNER					
0.5	14%	16%	10%	58%	1%	0.5	24%	4%	2%	70%	0%
1	15%	17%	11%	56%	1%	1	25%	4%	3%	67%	0%
2	15%	18%	11%	55%	1%	2	27%	4%	3%	66%	0%
3	16%	18%	11%	55%	1%	3	27%	4%	3%	65%	0%
Relative variance in KLB						Relative variance in KLB					
0.5	0%	1%	0%	0%	98%	0.5	0%	1%	4%	1%	94%
1	0%	1%	0%	0%	98%	1	0%	1%	4%	1%	93%
2	1%	1%	0%	0%	98%	2	0%	1%	5%	1%	93%
3	1%	1%	0%	0%	98%	3	0%	1%	5%	1%	93%

In Table 10, the diagonal of the matrix (highlighted) represents the relative exogeneity. Based on the result of orthogonalised approach, the ranking of exogeneity is: 1. KLB 2. LNER 3. LCI. 4. LINP and 5. LCSM. Whereas in generalised approach, the ranking of exogenity is: 1. KLB 2. LNER 3. LINP. 4. LCI. 5. LCSM. The relative rank in exogeneity is stable across the forecast of 3 years' time. However, the ranking in the two approaches is not consistent at the third and fourth place but since we acknowledged the limitations of orthogonalised approach, we are in support of the result of generalised approach. Nonetheless, the generalised VDCs strengthen our earlier result in VECM that exchange rate and interest rate lead (rather than follow) the stock prices. It shows that interest rate is the most exogenous of all (98%) and exchange rate is the second (55%). Yet the KLIBOR only explains about less than 1.5% of the variance of all stock prices while NEER explains about 31%. Given this, it suggests that although KLIBOR is the strongest leader yet the impact on other variables in the model is minimal while the impact of exchange rates is much greater. More importantly, it shows that the impact of exchange rate varies across the markets and industries. It appears that import based industry i.e. Consumer Products (12%), is the most affected by the changes in exchange rate followed by KLCI (10%) and export based industry i.e. Industrial Products (8%). This could be explained by the mean value of NEER throughout the period (see previously descriptive statistic – Table

1) that shows most of the time Malaysia has undergone depreciation and thus probably hurto mostly the importing firm[4]. To a certain extent, this finding shows support to previous studies of Jayasinghe and Tsui (2008) and Narayan and Sharma (2011) that the impact of exchange rate changes is uniquely explained by individual structures of industry.

Essentially, the impulse response functions produce the same information as the VDCs except that they are presented in a graphical form. It maps out the dynamic response of a variable owing to a one-period standard deviation shock to another variable. Based on the applied generalised IRFs, we found that consistent with the earlier result, stock price for the market and the two industries are more sensitive to a 1% SD shock to the exchange rate as compared to the reverse. Interestingly for KLIBOR, the impact is minimal to all stock prices. In general, the response of all variables takes about four to six months to get back to the equilibrium.
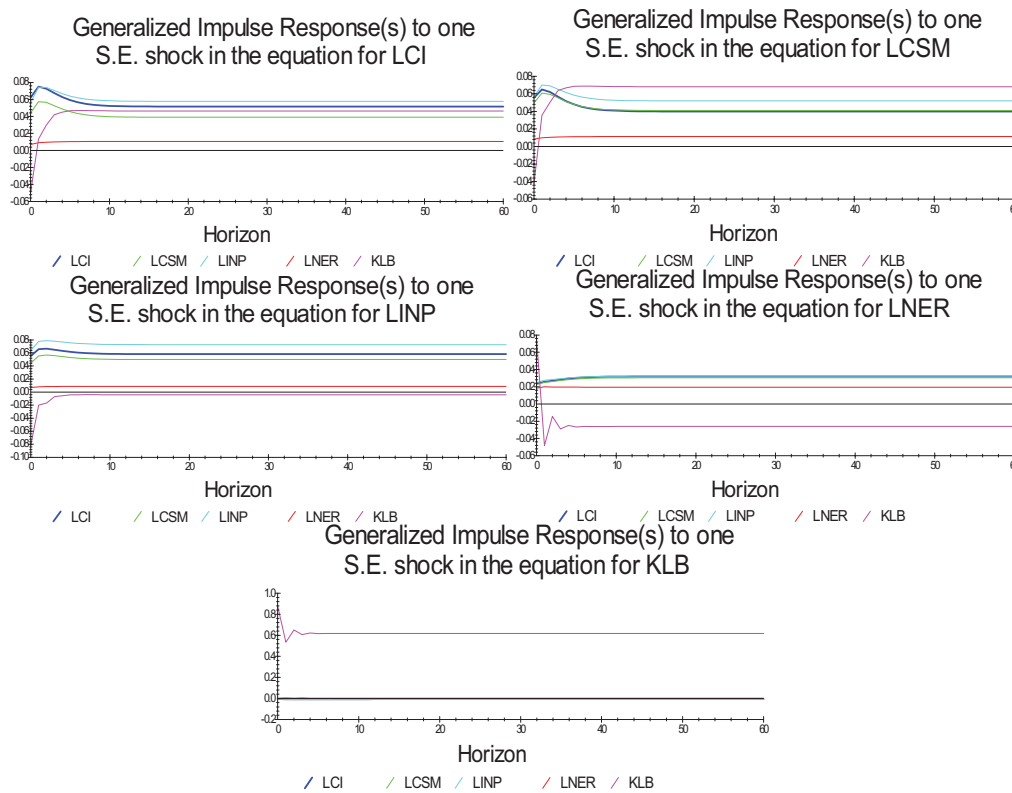
FIGURE 4. Generalised Impulse Response to One S.E. Shock in the equation for each variable

While IRFs deals with a variable specific shock (i.e. we shock one variable and see the impact on others), persistence profile uses a system-wide shock, where the shock comes from an external source to affect the entire co-integrating equation on the long run. Figure 4 shows that it will take about six to seven months for the co-integrating relationship to restore to equilibrium following a system-wide shock.
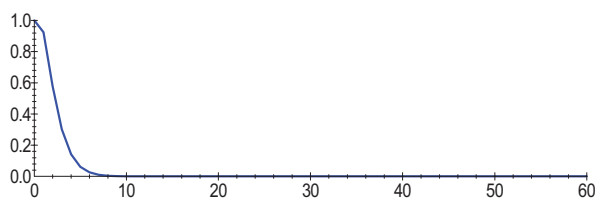
FIGURE 5. Persistence profile of the effect of a system-wide shock to CV

MANAGERIAL IMPLICATIONS

The findings have several economic and policy implications. Firstly, portfolio managers and hedgers will be able to formulate better investment decisions and adopt appropriate hedging strategies to guard against currency shocks particularly for importing industries where the currency exposure has been found more severe. Secondly it can be suggested for emerging countries like Malaysia; the development of stock market can be enhanced by pursuing active policy of currency stabilization (i.e. foreign exchange market intervention) through monetary instrument.

CONCLUSION

This study examines the direction of causality between exchange rates and stock prices of the market as well as

two main export and import based industries (Industrial Products and Consumer Products) in Malaysia from March 1994 to December 2013. Motivated by the intervention of financial authorities in the foreign exchange market, we also incorporated interest rate in the model so as to fully capture the relationship between exchange rates and stock prices. We employed the multivariate time series approach such as VECM (including LRSM) and variance decompositions. The findings reveal that the lead lag relationship between exchange rate and stock price is in support of flow oriented theory (rather than stock-oriented). Although we found that interest rate ranks first being the leader, yet its impact on stock prices is minimal as compared to the impact of exchange rate which poses greater influence. The magnitude and to a certain degree, sign of currency exposures on two Malaysian industries vary, suggesting the importance of industrial structure i.e. heterogeneous of the market (Jayasinghe & Tsui 2008; Narayan & Sharma 2011). It appears that import based industry is the most affected by the changes in exchange rates followed by KLCI and export based industry. To a certain extent, it shows support of the argument put forward by (Dornbusch & Fischer 1980) on goods market theory, in that, depreciation is expected to increase the exporting firms' value and hurting the importing firms, and in this case, the effect is more significant on the latter.

This study has its limitation in which the selection of industries is limited to only two industries. Many other industries could be tested such as plantation for export-based industry and, or electrical and electronic appliance as well as crude and refined petroleum for import-based industry. The selection of Consumer Product and Industrial product however, was favoured since we used the sectoral indices sourced by Bursa Malaysia in which the classification is not based on trade sectors. Besides, our preliminary check on the test of correlation has suggested that we should not include plantation in the model since it shows high correlation with both industrial products and consumer products. Moreover, besides interest rates it could be more comprehensive to include foreign reserve as another control variable to fully capture the foreign exchange market intervention by the central bank. Other than that it could be interesting to revisit the issue by looking at how crisis will affect the intensity of co-movement between the exchange rate and stock prices of the market in general, and of the industries in particular.

ENDNOTES

1. The selected two sectors are based on their significant contribution in Malaysian GDP. We include industrial product instead of plantation as main export-based industry after we found that the later is highly correlated with both industrial product and consumer product.
2. The co-integrating equation somehow suggests that exchange rates exposure poses significant influence on stock prices. The magnitude and to a certain degree, sign of currency exposures on the two Malaysian industries and market vary, suggesting that Malaysian market is not homogenous (Jayasinghe & Tsui 2008; Narayan & Sharma, 2011).
3. The presence of autocorrelation, functional form, normality and heteroscedasticity in the model could be the factor of insignificance of KLB in affecting the relationship between the variables in LRSM equation. The violation of normality and homoscedasticity in all model is expected since we use speculative or high frequency of financial time series data.
4. Malaysian NEER is in the form of indirect quotation in which the positive value represents depreciation.

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